

# A comparative Study of Yoga and Ayurvedic intervention in the Management of Type 2 Diabetes Mellitus

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## Abstract

Type II diabetes mellitus (T2DM) is an important human ailment afflicting people from various walks of life in different countries. Although various treatment methodologies have been adopted for the management of this disease, its holistic management is still a challenge. Several researchers have used traditional treatment methodologies like *ayurveda* and yoga for the treatment of T2DM and have found encouraging results without any side effects. The present study compares the effectiveness of a yoga practices package and an *ayurvedic* (herbo-mineral) formulation developed by the authors in the management of T2DM. The yoga practices package and ayurvedic (herbo-mineral) formulation were prescribed to two different groups of T2DM patients for one year along with dietary restrictions. 15 diagnosed T2DM patients were selected for each group through accidental sampling. In both the groups, there was significant reduction in Fasting Blood Sugar (FBS), Post Partum Blood Sugar (PPBS), Glycylated Hemoglobin (HbA1C) and Urine Sugar Fasting levels. There was no significant difference in the results for both the groups. No side effects were noted during the study period. This study suggests that the yoga practices package and the ayurvedic (herbo-mineral) formulation developed in the present study have reasonably good effect in the management of T2DM and the effectiveness of both is comparable.

**Key Words:** Type II diabetes mellitus, Yoga, Ayurvedic formulation, Blood glucose

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## Yoga and Ayurveda in the Management of Type 2 Diabetes Mellitus

### Introduction:

Type II diabetes mellitus (T2DM) is one of the most severe metabolic pandemic of the 21<sup>st</sup> century. It is estimated that in the year 2000, 171 million people had diabetes, and this is expected to double by the year 2030 [Boon et al., 2006]. In 2009, Wild et al. (2009) reported that India had the largest population of patients affected with T2DM, i.e. about 31.7 million.

The quality of life of T2DM patients, with chronic and severe hypoglycemia, is adversely affected. Characteristic symptoms of tiredness and lethargy can become severe and lead to a decrease in work performance. The most common acute complications are metabolic problems and infection [Davidson, 1991]. The impacts of T2DM are considerable. As a lifelong disease, it increases morbidity and mortality. At the same time, the disease and its complications cause a heavy economic burden for diabetic patients, their families and society [Hoskote and Joshi, 2008]. Thus, management of T2DM is one of the most important needs of the present times.

T2DM is often initially managed by increasing exercise and dietary modification; medications are typically needed as the disease progresses [ADA, 2008]. Modern medicines, despite offering a variety of effective treatment options, can have several adverse effects [Kelly, 1995; Parving et al., 1992].

With reference to ancient ayurvedic texts, T2DM resembles *Avaranajanya Madhumeha*, which was declared to be *kashtasadhya* (difficult to treat), by ancient ayurvedic scholars [Shukla and Tripathi, 2002; Cha.Su.17:78-80]. From ancient times, various ayurvedic herbal preparations have been used in the treatment of diabetes. In recent years also, several researchers have studied the use of ayurvedic herbal and mineral formulations in the treatment of T2DM [Bhardwaj et al., 2012; Anas et al., 2011; Trivedi et al., 2004] and have found encouraging results without any side effects.

Yogic postures (*asanas*) have also been found to be very effective in the treatment of T2DM. Nayak and Shankar (2004) have stated that Yoga exercises strengthen and increase the tone of weak muscles, and help in the conscious control over autonomic functions of the body. Yoga postures help in the development of correct breathing patterns, bowel habits, and regular sleeping patterns, and, teach the art of relaxation, relieving muscular and nervous tension, and leading to increased energy. Yoga is believed to improve blood circulation, enhance the activity of the pancreas, stimulate insulin secretion, promote digestion, and help with disease control [Sahay, 1994].

In recent years, several studies involving yoga practices have been found to be effective in the treatment of T2DM [Rani and Sreekumaran, 2013; Singh et al., 2008; Malhotra et al., 2005].

Thus, the present study compares the effectiveness of a yoga practices package and an ayurvedic (herbo-mineral) formulation developed by the authors [Bhardwaj, 2012] in the management of T2DM.

### Materials and Methods:

The ayurvedic formulation used in the present study [Bhardwaj et al., 2012] was a herbs and herbo-mineral formulation, comprising of 8 indigenous medicinal plants, namely *Tinospora cordifolia* (*Giloya*) stem, *Gymnema sylvestre* (*Gudmar*) leaves, *Cinnamomum tamala* (*Tejpatt*) leaves, *Emblica officinalis* (*Amalki*) fruit, *Syzygium cumini* (*Jamun*) seed, *Trigonella foenum-graecum* (*Methi*) seed, *Curcuma longa* (*Haridra*) rhizome, *Picrorhiza kurroa* (*Katuki*) rhizome, and one herbo-mineral, i.e. *Asphaltum puniabium* (*Shilajit*) oozing (*Satt*). These herbs and herbo-mineral are well known in the traditional Ayurveda system of medicine for their various therapeutic properties, especially hypoglycemic activity. This ayurvedic

formulation was administered to the patients as herbal *ghan* (extract) *vatis* (pills). Further details regarding the selected herbs and herbo-mineral, and the preparation of the *ghan* (extract) *vatis* are given in [Bhardwaj et al., 2012].

Yoga practices package prescribed in the present study included: *Kriya Yoga* (cleansing practice) - *Laghu-Shankha Prakshalana* (short intestinal wash); *Asanas* (postures) - *Surya Namaskara* (Sun Salutation), *Ardha-Matsyendrasana* (Half Spinal Twist), *Sarvangasana* (Shoulder Stand Pose), *Pawan-muktasana* (Air releasing posture); *Pranayamas* (Breathing Practices) - *Nadisodhan Pranayama* (Alternate Nostril Breathing), *Bhastrika Pranayama* (Below breath); *dhyana* (meditation) - *OM'kar* (AUM chanting); and, Relaxation - *Savasana* (Corpse pose). Further details regarding the Yoga practices, associated breathing technique/pattern, bodily postures, number of rounds of practice, and time duration are given in [Bhardwaj, 2012].

The ayurvedic formulation and yoga practices package were administered to two different groups of randomly selected 15 out-patient department (OPD) patients of T2DM each, including 10 males and 5 females, between the age of 40 to 70 years (accidental sampling was adopted for selection). These patients had: (i) Clinical symptoms of diabetes, (ii) Fasting Blood Sugar (FBS)  $\geq 126$  mg/dl (Fasting: zero calorie for 8 hr), (iii) Post Partum Blood Sugar (PPBS)  $\geq 200$ mg/dl, (iv) Glycosylated Hemoglobin (HbA1C)  $> 7$  %, and (v) Urine Sugar Fasting was positive. These diagnostic criteria were chosen based on the recommended guidelines of three common standards, i.e. WHO (1999), IDF (2005) and ADA (2006). These patients were suffering from T2DM for less than 3 years. It was made sure that the selected patients were not suffering from any complications.

The 15 T2DM patients in the ayurvedic formulation group were administered solid extract *vati* (prepared from Ayurvedic formulation) at a dose of two *vati* (each *vati* of 400 mg), twice a day, with lukewarm water, before taking morning and evening meals (empty

stomach), for twelve months duration. Before this study, the patients had been taking as usual treatment. However, during the course of the present study, the patients did not take any other medication for T2DM besides ayurvedic formulation.

The 15 T2DM patients in the yoga practices package group were advised to practice this package daily for 45 min in the early morning and 45 min in the evening (*asanas* – 15 min, *pranayama* – 15 min, and, relaxation – 15 min) for twelve months. Cleansing practice, i.e. *Laghu-Shankha Prakshalana* (short intestinal wash) was advised twice per month for duration of 60 min. Before this study, the patients had been taking as usual treatment. However, during the course of the present study, the patients did not take any medication for T2DM.

Besides this, the patients in both the groups were suggested to walk 1 to 3 km daily in the morning, and follow the seasonal diet (calorific vegetarian diet: 1400-1600 calories).

Diabetic diagnostic parameters, i.e. FBS, PPBS, HbA1C and Urine Sugar Fasting of the patients in the two groups were monitored. The pre test and the post test results were compared to assess and compare the effectiveness of the ayurvedic formulation and yoga practices package in reducing blood and urine glucose levels of T2DM patients. Statistical analysis was done using paired t-test to measure the significant difference between the means of Pre-test and Post-test values.

### Results:

The Pre-test and Post-test values of the diabetic parameters, i.e. FBS, PPBS, HbA1C and Urine Sugar Fasting were measured for the T2DM patients in both the study groups, i.e. ayurvedic formulation group and yoga practices package group.

### ***FBS Values of the T2DM Patients in the Two Study Groups***

Table 1 lists the Pre-test and Post-test Mean FBS values of the T2DM patients in both the study groups, i.e. ayurvedic formulation group and yoga practices package group. The standard range of FBS values for patients that test positive for T2DM is FBS  $\geq$  126 mg/dl, while that for normal individuals is between 70–110 mg/dl [WHO (1999), IDF (2005), ADA (2006)].

It can be seen from Table 1 that at the beginning of the study, the mean FBS value of the patients in the ayurvedic formulation group was 153.47 mg/dl, which decreased significantly at the end of the study period to a mean FBS value of 103.6 mg/dl ( $p < 0.001$ ,  $t = 35.53$ ,  $n = 15$ ) [Bhardwaj et al. (2012)], which is within the range of FBS values for normal individuals.

Table 1 also shows that at the beginning of the study, the mean FBS value of the patients in the yoga practices package group was 153.53 mg/dl,

which is comparable to the initial Mean FBS value for the ayurvedic formulation group. The mean FBS value of the patients in the yoga practices package group decreased significantly at the end of the study period to 109.20 mg/dl ( $p < 0.001$ ,  $t = 27.21$ ,  $n = 15$ ) [Bhardwaj (2012)], which is within the range of FBS values for normal individuals.

Furthermore, at the end of the study period, the mean FBS value of the patients in the yoga practices package group (153.53 mg/dl) was comparable to that for the ayurvedic formulation group (103.6 mg/dl) ( $p > 0.1$ ,  $t = 1.29$ ,  $n = 30$ ) [Bhardwaj (2012)].

Thus, it can be concluded that both the ayurvedic formulation and the yoga practices lead to significant reduction in the Mean FBS values of T2DM patients, and the effect of both the treatment methods was comparable.

**Table 1: Pre-test and Post-test Mean FBS values of the T2DM patients in the ayurvedic formulation group and the yoga practices package group.**

Diabetic Parameter Values	Ayurvedic Formulation Group	Yoga Practices Package Group
Mean FBS - Pre	153.47 mg/dl	153.53 mg/dl
Mean FBS - Post	103.60 mg/dl	109.20 mg/dl

### ***PPBS Values of the T2DM Patients in the Two Study Groups***

Table 2 lists the Pre-test and Post-test Mean PPBS values of the T2DM patients in both the study groups, i.e. ayurvedic formulation group and yoga practices package group. The standard range of PPBS values for patients that test positive for T2DM is  $PPBS \geq 200$  mg/dl, those with PPBS below 180 mg/dl are considered controllable, while the PPBS value for normal individuals is  $< 140$  mg/dl [WHO (1999), IDF (2005), ADA (2006)].

It can be seen from Table 2 that at the beginning of the study, the mean PPBS value of the patients in the ayurvedic formulation group was 251.00

mg/dl, which decreased significantly at the end of the study period to a mean PPBS value of 175.65 mg/dl ( $p < 0.001$ ,  $t = 30.19$ ,  $n = 15$ ) [Bhardwaj et al. (2012)], which is within the controllable range of PPBS values.

Table 2 also shows that at the beginning of the study, the mean PPBS value of the patients in the yoga practices package group was 253.40 mg/dl, which is comparable to the initial Mean PPBS value for the ayurvedic formulation group (251.00 mg/dl). The mean PPBS value of the patients in the yoga practices package group decreased significantly at the end of the study period to 176.93 mg/dl ( $p < 0.001$ ,  $t = 31.79$ ,  $n = 15$ ) [Bhardwaj (2012)], which is within the controllable range of PPBS values.

Furthermore, at the end of the study period, the mean PPBS value of the patients in the yoga practices package group (176.93 mg/dl) was comparable to that for the ayurvedic formulation group (175.65 mg/dl) ( $p>0.1$ ,  $t=0.72$ ,  $n=30$ ) [Bhardwaj (2012)].

Thus, it can be concluded that both the ayurvedic formulation and the yoga practices lead to significant reduction in the Mean PPBS values of T2DM patients, and the effect of both the treatment methods was comparable.

**Table 2: Pre-test and Post-test Mean PPBS values of the T2DM patients in the ayurvedic formulation group and the yoga practices package group.**

Diabetic Values	Parameter Ayurvedic Formulation Group	Yoga Practices Package Group
Mean PPBS - Pre	251.00 mg/dl	253.40 mg/dl
Mean PPBS - Post	175.65 mg/dl	176.93 mg/dl

### ***HbA1C Values of the T2DM Patients in the Two Study Groups***

Table 3 lists the Pre-test and Post-test Mean HbA1C values of the T2DM patients in both the study groups, i.e. ayurvedic formulation group and yoga practices package group. The standard range of HbA1C values for patients that test positive for T2DM is  $HbA1C \geq 7.0\%$ , those with  $HbA1C < 7\%$  are considered controllable, while the HbA1C value for normal individuals is  $< 6.4\%$  [WHO (1999), IDF (2005), ADA (2006)].

It can be seen from Table 3 that at the beginning of the study, the mean HbA1C value of the patients in the ayurvedic formulation group was 7.53%, which decreased significantly at the end of the study period to a mean HbA1C value of 6.48% ( $p<0.001$ ,  $t=16.41$ ,  $n=15$ ) [Bhardwaj et al. (2012)], which is within the controllable range of HbA1C values.

Table 3 also shows that at the beginning of the study, the mean HbA1C value of the patients in

the yoga practices package group was 7.53%, which is comparable to the initial Mean HbA1C value for the ayurvedic formulation group (7.53%). The mean HbA1C value of the patients in the yoga practices package group decreased significantly at the end of the study period to 6.55% ( $p<0.001$ ,  $t=16.01$ ,  $n=15$ ) [Bhardwaj (2012)], which is within the controllable range of HbA1C values.

Furthermore, at the end of the study period, the mean HbA1C value of the patients in the yoga practices package group (6.55%) was comparable to that for the ayurvedic formulation group (6.48%) ( $p>0.1$ ,  $t=0.69$ ,  $n=30$ ) [Bhardwaj (2012)].

Thus, it can be concluded that both the ayurvedic formulation and the yoga practices lead to significant reduction in the Mean HbA1C values of T2DM patients, and the effect of both the treatment methods was comparable. The ayurvedic formulation and the yoga practices did not display any side effects.

**Table 3: Pre-test and Post-test Mean HbA1C values of the T2DM patients in the ayurvedic formulation group and the yoga practices package group.**

Diabetic Values	Parameter Ayurvedic Formulation Group	Yoga Practices Package Group
Mean HbA1C - Pre	7.53 %	7.53 %
Mean HbA1C - Post	6.48%	6.55%

### ***Urine Sugar Fasting of the T2DM Patients in the Two Study Groups***

The value of Urine Sugar Fasting is positive for T2DM patients and 'nil' for a normal individual.

The Pre Urine Sugar Fasting values for all the T2DM patients in the ayurvedic formulation group ranged from +1 to +3. At the end of the study period, the Urine Sugar Fasting value became 'nil', i.e. normal value, for 9 out of the 15 patients. Another 3 patients had 'trace' Urine Sugar Fasting, and only 3 patients tested positive, i.e. +1 value for Urine Sugar Fasting. This shows that ayurvedic formulation had a significant impact in reducing the Urine Sugar Fasting values in T2DM patients.

The Pre Urine Sugar Fasting values for all the T2DM patients in the yoga practices package group ranged from +1 to +3. At the end of the study period, the Urine Sugar Fasting value became 'nil', i.e. normal value, for 9 out of the 15 patients. Another 3 patients had 'trace' Urine Sugar Fasting, and only 3 patients tested positive, i.e. +1 value for Urine Sugar Fasting. This shows that yoga practices had a significant impact in reducing the Urine Sugar Fasting values in T2DM patients.

Thus, it can be concluded that both the ayurvedic formulation and the yoga practices lead to significant reduction in the Urine Sugar Fasting values for T2DM patients, and the effect of both the treatment methods was comparable.

### **Discussion:**

The possible mechanism for the hypoglycemic activity of the ayurvedic formulation used in the present study may be the stimulation/regeneration effect on beta cells, promotion of insulin secretion and reduction of insulin resistance [Bhardwaj et al., 2012]. The decrease in the elevated blood glucose level of T2DM patients caused by the ayurvedic formulation may be attributed to its ingredients, whose anti-diabetic effects have been described in the open literature [Bhardwaj et al., 2012]. The

ingredients include *Giloya* stem, which has anti-diabetic properties and hypoglycemic activity; leaf of *Gudmar*, which performs several significant functions like suppressing blood glucose, insulinotropic effect and promoting insulin secretion; *Jambu* seed, which has shown significant hypoglycemic action in both urine and blood glucose; *Amalaki* fruit, which exhibits hypoglycemic, hypolipidaemic action; *Tejapatra* leaf, which exhibits anti-hypercholesterolemia and anti-hypertriglyceridemic effects; *Tejapatra* leaves extract, which induces antihyperglycemic, as well as antioxidant activities; *Haridra* rhizome extracts, which have shown hypoglycemic effect, hypocholesterolemic effect and blood glucose lowering activity; *Methi* seed, which acts as a hypoglycemic and anti-inflammatory agent; rhizome of *Katuki*, which has hepatoprotective and anti-diabetic activity, is a proven hypoglycemic agent and has *Pramehahara* properties; and, *Shilajit* (*A. puniabiunum*), a *rasayana* herb, which reduces insulin resistance in T2DM patients. The relevant references for these observations have been listed in [Bhardwaj et al., 2012].

Gore (1985) has explained the possible mechanism for the hypoglycemic activity of yoga practices as follows: (a) Direct influence on pancreatic secretion by rejuvenation of the pancreatic cell through alternate abdominal contractions and relaxation during *asanas* (yoga postures) and breathing exercises; (b) Reduction in blood sugar due to muscular exercise involved in the *asanas*.

### **Conclusions:**

In the present study, an ayurvedic (herbo-mineral) formulation and a yoga practices package were prescribed to two groups of 15 T2DM patients each, for one year along with dietary recommendations. Diabetic diagnostic parameters of these patients, i.e. FBS, PPBS, HbA1C and Urine Sugar Fasting were measured. The pre test and the post test results were compared to assess the comparative effectiveness of the ayurvedic formulation and

yoga practices in reducing blood and urine glucose level in T2DM patients.

It was found that ayurvedic formulation and yoga practices were significantly effective in reducing the blood and urine sugar level in T2DM patients, as well as the result for both the groups was comparable. After one year of treatment, the mean FBS value became normal and the mean PPBS and mean HbA1C values came within the controllable range for both the groups. The ayurvedic formulation and the yoga practices did not display any side effects. Thus, it can be concluded that the ayurvedic formulation and the yoga practices used in the present study have significant anti-hyperglycemic effect for T2DM patients and their results are comparable.

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